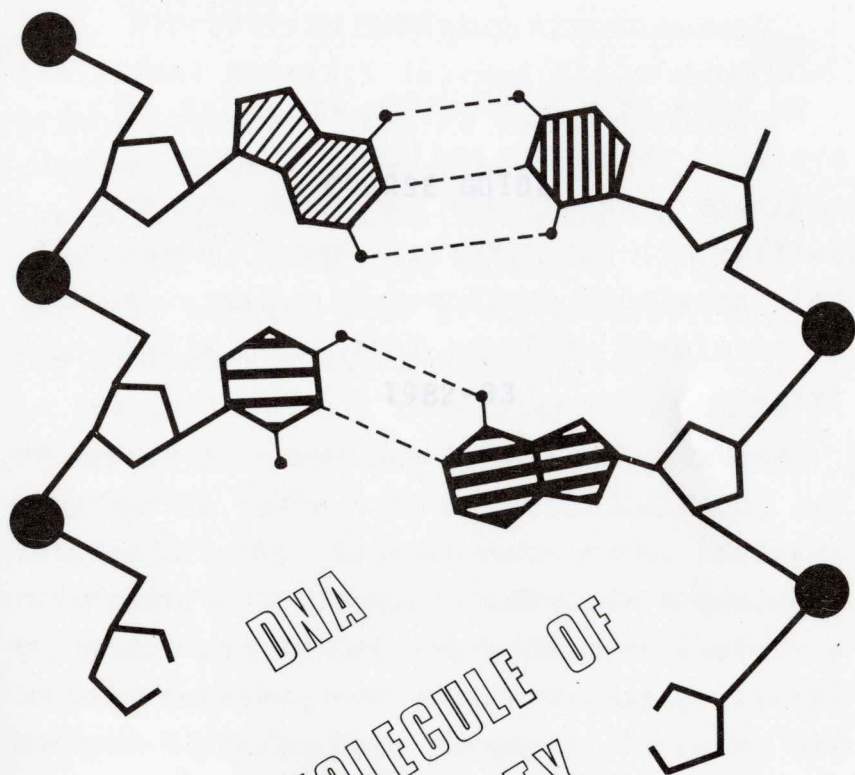


# CONCORDIA UNIVERSITY



## ARTS AND SCIENCE CHEMISTRY



DNA  
THE MOLECULE OF  
HEREDITY

1982-83



CONCORDIA UNIVERSITY

CHEMISTRY DEPARTMENT

COURSE GUIDE

1982-83

## SCIENCE OF CHEMISTRY

"The study of chemistry is profitable, not only inasmuch as it promotes the material interests of mankind, but also because it furnishes us with insight into those wonders of creation which immediately surround us, and with which our existence, life and development are most clearly connected."

Justus von Liebig (1851)

We live in a scientific age which is so profound that some believe "science" can ultimately answer all our questions and satisfy all our material needs. However, this knowledge developed by science, must be carefully utilized to achieve a satisfying life.

Chemistry is one of the two most basic of the physical sciences (the other being physics) which most directly affects our everyday life. The chemist, like others in a rapidly expanding discipline has found it necessary to specialize and therefore there are physical, organic, analytical, inorganic chemistry and biochemistry. Each chemist in being highly versed with the fundamentals of chemistry and the nature of the various branches within it, quickly recognizes the



interdependence of each. Because of this, all discoveries and inventions have been the rewards of co-operative efforts between the various groups of chemists.

Our cover logo, the simplified and schematic partial structure of a nucleic acid called deoxyribonucleic acid (DNA) the molecule of heredity, was elucidated through the co-operation of all branches of chemistry. Biochemists isolated the compound, analytical chemists learned its composition, organic chemists studied the structure of components and synthesized models of it. The physical chemist elucidated the overall structure of this huge molecule, using physical methods like X-ray crystallography, and biochemists again studied its function in transmitting all hereditary properties of all living organisms from generation to generation. The importance of all this knowledge cannot be overestimated. The researcher, in close co-operation with his colleagues continues to establish the intricate details of the correlation between structure and function.

## CHEMISTRY DEPARTMENT

### COURSE GUIDE

1982-83

This booklet is intended to give prospective students an idea of programs in the Department and a general course description. More detailed information may be obtained from the University Undergraduate Calendar Section 31.8.

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## GENERAL INFORMATION

### (i) Admission Requirements

- (a) Quebec. Successful completion of a two-year, pre-university programme in a CEGEP with the award of a Diploma of Collegial Studies or its equivalent, satisfies the requirements for admission to the 90-credit undergraduate programme. Graduates of three-year technological programmes in CEGEP's are also admissible.

Specific courses must be successfully completed within the student's general CEGEP programme for admission to a particular department. The pre-university "profiles" (see below, "Chemistry Profile") have been established through joint action of the Quebec Universities and the Department of Education of the Province.

#### "CHEMISTRY PROFILE"

Mathematics 103, 203

Physics 101, 201, 301-78

Chemistry 101, 201

Biology 301



(b) Other Canadian Provinces

Non-Quebec applicants may be considered for admission to the 90-credit programme or an extended credit undergraduate programme. The duration of the programme will be determined by the entrance qualifications.

(ii) Registration

Registration for the September and January terms normally takes place in late August and mid-December respectively. Complete information is sent with the letter of acceptance.

(iii) Your Personal Contact

All students interested in a Chemistry or Biochemistry programme should visit or contact one of the two student co-ordinators:

Loyola Campus      Dr. M. Doughty  
(482-0320, ext 284)

S.G.W. Campus      Dr. K. Ekler  
(879-8467)

All students in the Chemistry Co-op programme should visit or contact:

Loyola Campus      Dr. G. Trudel  
(482-0320, ext 331)

S.G.W. Campus      Dr. R. Townshend  
(879-5963)

(iv) Scholarships, Awards, Medals, Prizes, etc.

Scholarships and prizes are given in recognition of academic achievements. Our graduates have an admirable record in being awarded N.R.C. and Centennial Scholarships. One of the two coordinators in the Department will advise you, on request, how to apply for these awards. In addition, it is possible to obtain financial assistance in the form of bursaries and loans.

(v) Departmental Facilities

The Department has the necessary equipment and instrumentation to prepare our graduates for either industry or graduate school. The physical facilities are housed on:

- (a) The Loyola Campus on the 2nd, 3rd and 4th floors of the Drummond Science Building located at the corner of West Broadway and Sherbrooke Streets. Library facilities are conveniently located on the 2nd floor.
- (b) The Sir George Williams Campus, on the 10th and 11th floors of the modern air-conditioned Hall Building located at

1455 de Maisonneuve Boulevard West. Library facilities are conveniently located on the 10th floor, which include resource room, study area and audio-visual materials; open to all students in Chemistry. Modern calculating equipment is also available to all students in Chemistry.

STUDENTS ARE ENCOURAGED TO CONSULT AND  
CONFER WITH THE FACULTY.

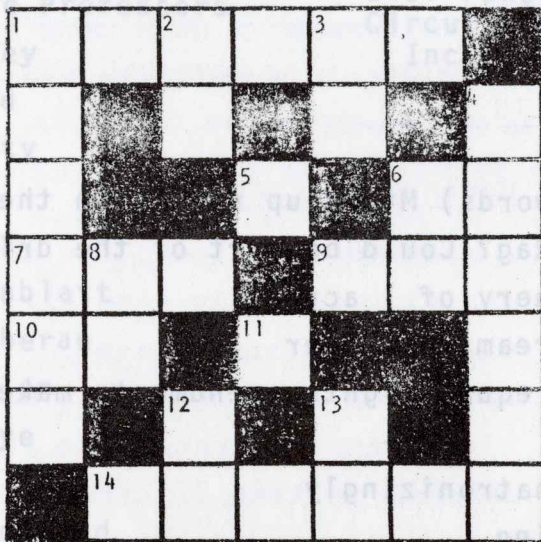


# CHEMICAL CROSSWORD

Alan G. Ryan

Reprinted from Chem 13 News by permission

Each box of the crossword contains a chemical symbol rather than the customary letter of the alphabet. There is, therefore, the possibility that the word will have more letters than the number of squares: e.g. PuN would fit in two squares and has three letters. To confuse you further, the number of letters of the correct answers are not given.



The solution to this puzzle may be obtained by writing to: Concordia University,  
Dept. of Chemistry,  
1455 de Maisonneuve Blvd.  
Montreal, P.Q.  
H3G-1M8

ACROSS

1. Highly manoeuvrable aircraft
5. There must have been a paper log on this primitive vessel when it crossed the ocean!
6. One of Santa's 6 down
7. 11, 14 (three words) Story about a shrunken girl
9. If you do this, you keep
10. Earthly
11. See 7
14. See 7

DOWN

1. (two words) Mixed-up report on the Hale Lice Rag? Could be part of the drive machinery of 1 across!
2. Ice cream container
3. Short equal rights amendments make long times
4. Help patronizingly
6. Greeting
8. Moon of Jupiter
12. In short, a knockout!
13. Seat row - sounds like there was some crying done!

FULL TIME FACULTY

Chairman	J. Fraser
C.H. Langford, Professor	M.G. Hogben
Professors	J. Parkes
L.D. Colebrook	Research Fellow
J.G. Dick	S.J. Daunt
T. Nogrady	Adjunct Associate
N. Serpone	Professors
J.R. Ufford	D. Gamble
R.H.C. Verschingel	Agriculture Canada
Associate Professors	B.C. Pant
T.J. Adley	Circul-Aire Eastern
P.H. Bird	Inc.
M. Doughty	
K. Ekler	
Z. Hamlet	
M.J. Kornblatt	
D. McElcheran	
R.H. Pallen	
R.T.B. Rye	
O.S. Tee	
R.E. Townshend	
G.J. Trudel	
R.A. Westbury	
R.H. Zienius	
Assistant Professors	
M. Baldwin	
A. English	

## THE AIMS OF THE TEACHING PROGRAMME

The programmes in Chemistry have clearly been designed to meet the specific needs of: (a) students who will make Chemistry their career; (b) students who intend to enter graduate school; (c) students who will complete their studies in other areas, but wish to have some knowledge of chemistry or work in chemically related fields.

## The Framework of the Various Programmes

The various programmes in Chemistry have been conceived within a definite framework. They are as follows:

### (a) Honours in Chemistry

A programme designed for students who plan to study chemistry beyond the undergraduate level. The programme is a demanding one, with high standards requiring the student to take 72 credits in specified courses out of the required 90 for a degree, in a set pattern.

### (b) Specialization Degree in Chemistry

A less intensive programme than the honours programme, but one which provides the students with



an excellent grasp of the subject. The student is required to take 60 credits in Chemistry but numerous electives in Chemistry are available. On an interesting note, other electives may be taken in Humanities, Social Sciences and Commerce.

(c) Specialization Degree in Biochemistry

With Options in Biochemistry and Medicinal Chemistry.

The Biochemistry programme is for students who wish to apply their knowledge of chemistry to biological systems. The student is required to take 72 credits in Chemistry and the Biological Sciences but a variety of electives are available in these subjects. The decision of which option to take, Biochemistry or Medicinal Chemistry is made only in the student's 3rd year.

(d) Specialization Degree in Analytical Chemistry

This programme which requires the student to take 73 credits in Chemistry is specifically designed

to enable a qualified student to work in analytical chemistry as applied in industry.

(e) Chemistry Co-Operative Programme

Director

G.J. Trudel, Associate Professor

The Chemistry Co-operative

Programme is offered to students

who are enrolled in the B.Sc.

Honours or Specialization in

Chemistry, Specialization in

Biochemistry, or Specialization in

Analytical Chemistry.

Students in CHEM Co-Op take the regular academic programme. The

schedule of academic and work

periods for an entering group of

CHEM Co-Op students is given in

(Sec) 31.515 in the University

Announcement.

The overseeing of the CHEM Co-Op

programme is the responsibility

of the Director and the departmental

Co-Op Committee, which provides the

connecting link between students,

employers and the Institute for

Co-operative Education.

Students interested in applying



for the CHEM Co-Op should refer to (Sec) 31.515 in the University Announcement, where a full description of the admission requirements is provided, or write to The Principal, Institute for Co-Operative Education, 7141 Sherbrooke Street West, Montreal, Quebec, H4B 1R6. For information by telephone see "CONTACTS" on page 2.

(f) Major in Chemistry

Options: Chemistry or Biochemistry. The student in such a programme is required to take 42 credits in an approved sequence. In such a programme, the student avails himself of numerous options.

(g) Minor in Chemistry

A 24 credit programme or 4 full courses. Such a programme leads to a Minor in Chemistry and can be arranged in consultation with one of the undergraduate advisors.

(h) Certificate in Scientific Measurement

This particular programme requires the student to take 33 credits in

Chemistry in specified courses.  
The programme is designed to  
meet a very specific need.

### AVAILABLE PROGRAMS

Students are responsible for satisfying their particular degree requirements.

All students are advised to include a course in a computer language to their degree programme.

The superscript indicates credit value.

NOTE: The Order of Chemists of Quebec has fully accredited the curricula of  
i) Honours in Chemistry, ii) Specialization in Analytical Chemistry,  
iii) Specialization in Biochemistry, iv) Specialization in Chemistry. Upon satisfactory completion of any of the above-mentioned programmes, a graduate is eligible for membership in the Order. A working knowledge of French is required.

72 B.Sc. Honours in Chemistry (72 credits)

Year I

24 CHEM C211<sup>6</sup>, C221<sup>3</sup>, C222<sup>3</sup>, C231<sup>2</sup>, C232<sup>2</sup>,  
C241<sup>3</sup>, C242<sup>3</sup>.  
3 MATH 220<sup>3</sup>.

Year II

26 CHEM C311<sup>2</sup>, C316<sup>1</sup>, C312<sup>2</sup>, C322<sup>2</sup>, C329<sup>2</sup>,  
C331<sup>2</sup>, C332<sup>2</sup>, C338<sup>2</sup>, C339<sup>2</sup>, C342<sup>2</sup>,  
C348<sup>1</sup>, C391<sup>3</sup>; C310<sup>2</sup> and C315<sup>1</sup>, or  
C314<sup>2</sup> and C319<sup>1</sup>.

- Year III
- 19 CHEM C450<sup>6</sup>, 3 credits of Physical Chemistry, 10 credits at the 400-level (6 credits must be in one area)
- 60 B.Sc. Specialization in Chemistry (60 credits + )
- 
- Year I
- 22 CHEM C211<sup>6</sup>, C221<sup>3</sup>, C222<sup>3</sup>, C231<sup>2</sup>, C232<sup>2</sup>, C241<sup>3</sup>, C242<sup>3</sup>.
- 3 MATH C220<sup>3</sup>.
- Year II
- 26 CHEM C311<sup>2</sup>, C316<sup>1</sup>, C321<sup>2</sup>, C322<sup>2</sup>, C329<sup>2</sup>, C331<sup>2</sup>, C332<sup>2</sup>, C338<sup>2</sup>, C339<sup>2</sup>, C342<sup>2</sup>, C348<sup>1</sup>, C391<sup>3</sup>; C310<sup>2</sup> and C315<sup>1</sup>, or C314<sup>2</sup> and C319<sup>1</sup>.
- Year III
- 9 3 credits of Physical Chemistry, 6 credits at the 400-level in one area. The nine credits required in Year III must include at least 2 credits of laboratory.
- 72 B.Sc. Specialization in Biochemistry (72 credits + )
- 
- Year I
- 16 CHEM C211<sup>6</sup>, C221<sup>3</sup>, C222<sup>3</sup>, C231<sup>2</sup>, C232<sup>2</sup>
- 6 BIOL C230<sup>3</sup>, C270<sup>3</sup>.
- Year II
- 19 CHEM C311<sup>2</sup>, C316<sup>1</sup>, C321<sup>2</sup>, C323<sup>2</sup>, C329<sup>2</sup>, C331<sup>2</sup>, C333<sup>2</sup>, C372<sup>3</sup>, C373<sup>3</sup>.
- 6 BIOL C364<sup>3</sup> and C260<sup>3</sup>; or C333<sup>6</sup>.
- Year III
- 6 CHEM C434<sup>3</sup>, C479<sup>3</sup>.
- 6 Chosen from CHEM C470<sup>3</sup>, C471<sup>3</sup>, C472<sup>3</sup>.
- 4 CHEM C338<sup>2</sup>, C339<sup>2</sup>.



### Biochemistry Option

- 3 400-level Biology  
6 3 credits chosen from CHEM C473<sup>3</sup>, C474<sup>3</sup>,  
or C475<sup>3</sup>, and 3 credits in Chemistry at  
the 300 or 400 level; or CHEM C450<sup>6</sup>.

### Medicinal Chemistry Option

- 9 CHEM C473<sup>3</sup>, C474<sup>3</sup>, C475<sup>3</sup>.

### 70-71 B.Sc. Specialization in Analytical Chemistry (70 credits +)

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#### Year I

- 22 CHEM C211<sup>6</sup>, C221<sup>3</sup>, C222<sup>3</sup>, C231<sup>2</sup>, C232<sup>2</sup>,  
C241<sup>3</sup>, C242<sup>3</sup>.  
6 COMP C211<sup>3</sup>, C221<sup>3</sup>.

#### Year II

- 26 CHEM C310<sup>2</sup>, C311<sup>2</sup>, C315<sup>1</sup>, C316<sup>1</sup>, C321<sup>2</sup>,  
C322<sup>2</sup>, C329<sup>2</sup>, C331<sup>2</sup>, C332<sup>2</sup>, C338<sup>2</sup>, C339<sup>2</sup>,  
C342<sup>2</sup>, C348<sup>1</sup>, C391<sup>3</sup>.  
3-4 CHEM C390<sup>2</sup>, C399<sup>1</sup> or PHYS C295<sup>2</sup>, C296<sup>2</sup>.

#### Year III

- 13 CHEM C314<sup>2</sup>, C319<sup>1</sup>, C419<sup>6</sup>, C492<sup>4</sup>.

### 42 B.Sc. Major in Chemistry (42 credits +)

---

#### Year I

- 22 CHEM C211<sup>6</sup>, C221<sup>3</sup>, C222<sup>3</sup>, C231<sup>2</sup>, C232<sup>2</sup>,  
C241<sup>3</sup>, C242<sup>3</sup>.  
20 Chosen from CHEM C302<sup>2</sup>, C310<sup>2</sup>, C311<sup>2</sup>,  
C313<sup>2</sup>, C314<sup>2</sup>, C315<sup>1</sup>, C316<sup>1</sup>, C319<sup>1</sup>,  
C321<sup>2</sup>, C322<sup>2</sup>, C323<sup>2</sup>, C326<sup>2</sup>, C328<sup>2</sup>,  
C329<sup>2</sup>, C331<sup>2</sup>, C332<sup>2</sup>, C333<sup>2</sup>, C335<sup>2</sup>, C338<sup>2</sup>,  
C339<sup>2</sup>, C342<sup>2</sup>, C348<sup>1</sup>, C372<sup>3</sup>, C373<sup>3</sup>, C380<sup>2</sup>,  
C390<sup>2</sup>, C391<sup>3</sup>, C399<sup>1</sup>.

(Other courses may be selected in  
consultation with the Department.)

### 42 B.Sc. Major in Biochemistry (42 credits +)

---

#### Year I

- 16 CHEM C211<sup>6</sup>, C221<sup>3</sup>, C222<sup>3</sup>, C231<sup>2</sup>, C232<sup>2</sup>.  
3 BIOL C270<sup>3</sup>.

14 Year II  
CHEM<sub>3</sub> C321<sup>2</sup>, C323<sup>2</sup>, C329<sup>2</sup>, C333<sup>2</sup>, C372<sup>3</sup>,  
C373<sup>3</sup>.

3 Year III  
CHEM C479<sup>3</sup>.

6 Credits chosen from CHEM C470<sup>3</sup>, C472<sup>3</sup>,  
C473<sup>3</sup>, C474<sup>3</sup>.

24 Minor in Chemistry (24 credits +)

22 CHEM C211<sup>6</sup>, C221<sup>3</sup>, C222<sup>3</sup>, C231<sup>2</sup>, C232<sup>2</sup>,  
C241<sup>3</sup>, C242<sup>3</sup>.

2 Credits chosen from Chemistry 300-level  
courses.  
(Other combinations may be arranged in  
consultation with the Department.)

33 Certificate in Scientific Measurement  
(Chemistry Option) (33 credits +)

19 CHEM C211<sup>6</sup>, C310<sup>2</sup>, C314<sup>2</sup>, C315<sup>1</sup>, C319<sup>1</sup>,  
C390<sup>2</sup>, C399<sup>1</sup>, C490<sup>3</sup>, C499<sup>1</sup>.

14 PHYS C295<sup>2</sup>, C296<sup>2</sup>, C396<sup>5</sup>, C397<sup>5</sup>.

Students may transfer into the Certif-  
icate Programme up to twelve credits  
earned in an incomplete degree or  
certificate programme or as an  
Independent or Special student, provided  
they are students in good standing. The  
credits that may be so transferred are  
determined by the University at the point  
of entry into the programme.



A student may be exempted from one or more of the introductory courses, on the basis of work done at CEGEP level. Where exemptions are given, the courses must be replaced with an equivalent number of credits in the sub-discipline involved, in order that the student successfully complete any of the programmes approved by the Order of Chemists of Quebec.

## CHEMISTRY C205

### General Chemistry I (3 credits)

Stoichiometry, states of matter, atomic structure, electron structure of atoms, the periodic table, periodic properties, bonding, solids. Lectures, tutorials, and laboratories.

NOTE: Students in programmes leading to the B.Sc. degree may not take this course for credits to be applied to their programme of concentration.

## CHEMISTRY C206

### General Chemistry II (3 credits)

Prerequisite: CHEM. C205. Thermochemistry, solutions and their properties, equilibrium, ionic equilibrium, pH, buffers, kinetics, reaction mechanisms, other selected topics related to biochemistry, biology, and engineering. Lecture, tutorials, and laboratories.

NOTE: Students in programmes leading to the B.Sc. degree may not take this course for credits to be applied to their programme of concentration.

## CHEMISTRY C208

Chemistry for Non-Science Students

(3 credits)

This course covers aspects of Chemistry which are of general interest to the non-science student. Sections deal with the social impact of chemistry and with chemistry of the natural environment.

NOTE: This course is not a prerequisite for any Chemistry course. Students in programmes leading to the B.Sc. degree may not take this course for credits.

## CHEMISTRY C211

Introductory Quantitative Analysis

(6 credits)

Prerequisite: CEGEP Chemistry 201; CEGEP Physics 301, CEGEP Mathematics 103 and 203; or equivalent courses. Treatment of analytical data; chemical equilibria as applied to volumetric and gravimetric procedures; general theory of titrations and titration curves; neutralization, precipitation, complexation, oxidation-reduction, and non-aqueous titrations, gravimetric analysis; potentiometry and potentiometric titrations; absorptimetric methods. Laboratory is taken concurrently and provides experience

in the techniques of analysis discussed in the lectures. Lectures and laboratory.

NOTE: A student who has obtained credits for GEOL C324 may not take this course for credits.

#### CHEMISTRY C221

Introductory Organic Chemistry I (3 credits)

Prerequisite: CEGEP Chemistry 201 or equivalent. Synthesis, structure, and reactivity of saturated and unsaturated hydrocarbons. Elementary stereochemistry, Chemistry of benzene. Lectures and laboratory.

#### CHEMISTRY C222

Introductory Organic Chemistry II  
(3 credits)

Prerequisite: CHEM C221 or one semester CEGEP Organic Chemistry. Synthesis, structure, and reactivity of principal functional groups. Simple reaction mechanisms.

#### CHEMISTRY C231

Introductory Physical Chemistry I  
(2 credits)

Prerequisite: CEGEP Chemistry 201;  
CEGEP Physics 301; CEGEP Mathematics 103



and 203, or equivalent courses. Real gases, equations of state (Van der Waal's, Virial, etc.), first law of thermodynamics, thermochemistry, entropy, and the second and third laws of thermodynamics, free energy and chemical equilibrium, electrochemical cells and the Nernst equation, use of activities, Gibbs-Helmholtz equation. Lectures only.

#### CHEMISTRY C232

Introductory Physical Chemistry II  
(2 credits)

Prerequisite: CHEM C231 or an equivalent course. Applications of thermodynamics to one-, two-, and three-component systems, including the properties of liquids, colligative properties, phase equilibria, kinetic molecular theory, chemical kinetics, the behaviour of electrolytes in solution. Lectures only.

#### CHEMISTRY C233

Introductory Quantum Chemistry (2 credits)

Prerequisite: MATH C220; CEGEP Chemistry 201, CEGEP Physics 301, or equivalent courses. This course is intended to introduce the student to the fundamental ideas of quantum theory as

applied to chemistry. Topics covered include the origins of quantum theory, the postulates of quantum mechanics, applications to simple systems, the hydrogen atom, other atoms, and simple molecules. Lectures only.

#### CHEMISTRY C241

Introduction to Inorganic Chemistry  
(3 credits)

Prerequisite: CEGEP Chemistry 201; CEGEP Physics 301; CEGEP Mathematics 103 and 203, or equivalent courses. The structure of the atom; Ionic Bonding; Covalent Bonding; Chemical Forces; Acid-Base Chemistry; Chemistry in Aqueous and Non-aqueous solutions. Lectures and laboratory.

#### CHEMISTRY C242

Chemistry of the Main Group Elements  
(3 credits)

Prerequisite: CEGEP Chemistry 201; CEGEP Physics 301; CEGEP Mathematics 103 and 203, or equivalent courses. A survey of the properties and reactions of: Hydrogen, Group IA Lithium to Cesium, Group IIA Beryllium to Radium, Group IIIA Aluminum to Thallium, Carbon, Group IVB Silicon to Lead, Nitrogen, VIB Sulphur to



Polonium, the Halogens, the Noble Gases, Group IIB Zinc, Cadmium, and Mercury. Lectures and Laboratory.

#### CHEMISTRY C282

Environmental Chemistry (2 credits)

Prerequisite: CEGEP Chemistry 201, or equivalent. General aspects of environment and ecology; cycles in nature. The chemistry of pollution, air-pollution, water pollution, water treatment. Compounds treated: oxides of carbon, nitrogen, and sulphur, hydrocarbons and types of particles. Photochemical and chain reactions. Mercury, lead, oil detergents, and insecticides will be examined with regard to their chemistry, and their contribution to pollution. Lectures only.

#### CHEMISTRY C302

Industrial Chemistry, Resources and Environment (2 credits)

Prerequisite: Must be registered in a Chemistry programme and be within 42 credits of graduation; or permission of the Department. An introduction to chemical engineering for chemists. Management and conservation of resources; pollution control; occupational and environmental

health; technological and environmental impact assessment.

### CHEMISTRY C303

Chemical Technology and Human Values  
(2 credits)

Prerequisite: Must be registered in a Chemistry programme and be within 42 credits of graduation; or permission of the Department. The history of technology; the impact of chemistry on material life; appropriate technologies; chemistry and war; the social responsibility of the scientist.

### CHEMISTRY C310

Electrochemical Methods of Analysis  
(2 credits)

Prerequisite: CHEM C211; CHEM C315 concurrently. Topics in theory and application involving potentiometry and potentiometric titrations; automated methods; polarization titrations; coulometry and coulometric titrations; electrogravimetry and electrolytic separations; voltametry and polarography; pulse and sweep methods; amperometric titrations; conductometric techniques; chronopotentiometry and chronoamperometry.

Lectures only.

### CHEMISTRY C311

Introductory Analytical Organic Chemistry I  
(2 credits)

Prerequisite: CHEM C211 and C222, or CHEM C222 and 6 credits in Biology course(s) with laboratory, CHEM C316 concurrently, Identification of organic compounds and trace impurities by chemical and instrumental methods. Discussion of analytical procedures, sample preparation, and instrumental methods, with emphasis on spectroscopic methods. Lectures only.

### CHEMISTRY C313

Environmental Pollution and Pollutant Analysis (2 credits)

Prerequisite: CHEM C222, and any one of CHEM C211, C372 and C373, BIOL C250; Scope and purpose of environmental chemistry; nature and composition of natural waters; pollution and trace-level substances in water; water analysis; nature and composition of the atmosphere; atmospheric levels of the oxides of carbon, sulphur, and nitrogen; organic, inorganic and particulate pollutants in the atmosphere; monitoring and analysis of pollutants in



the atmosphere. Lectures only.

#### CHEMISTRY C314

Optical Methods of Analysis (2 credits)

Prerequisite: CHEM C211; CHEM C319 concurrently. Theory and application of absorptimetric, turbidimetric, nephelometric, and fluorescence techniques; flame absorption and emission spectroscopy; electrical and plasma arc emission spectroscopy; atomic absorption flame and flameless techniques; X-ray fluorescence and diffraction methods; X-ray microprobe methods; radiochemical techniques. Lectures only.

#### CHEMISTRY C315

Electrochemical Methods of Analysis  
Laboratory (1 credit)

Prerequisite: CHEM C211; CHEM C310 concurrently. Analytical experiments providing experience in the methods discussed in CHEM C310. Laboratory only.

#### CHEMISTRY C316

Introductory Analytical Organic Laboratory I  
(1 credit)

Prerequisite: CHEM C211 and C222, or CHEM C222 and 6 credits in Biology course(s)



with laboratory; CHEM C311 concurrently. Macro- and semimicro- separation techniques and procedures providing experience in the methods discussed in CHEM C311. Laboratory only.

#### CHEMISTRY C319

Optical Methods of Analysis Laboratory  
(1 credit)

Prerequisite: CHEM C211; CHEM C314 concurrently. Analytical experiments providing experience in the methods discussed in CHEM C314. Laboratory only.

#### CHEMISTRY C321

Organic Stereochemistry (2 credits)

Prerequisite: CHEM C222, or equivalent and C232. Conformational analysis of acyclic and cyclic systems. Relationship to physical properties and chemical reactivity: Chirality, enantiomerism, diastereomerism, diastereotopism. Examples from steroids, carbohydrate, and enzyme mediated reactions. Lectures only.

#### CHEMISTRY C322

Organic Reactions (2 credits)

Prerequisite: CHEM C321 and C331, previously or concurrently. A mechanistic

survey of reactions of major synthetic utility. Determination of reaction mechanisms. Importance of reactive intermediates: carbocations, carbanions, radicals, and carbenes. Lectures only.

#### CHEMISTRY C323

##### Bio-Organic Chemistry (2 credits)

Prerequisite: CHEM C321, Chemistry of carbohydrates. Aspects of heterocyclic chemistry, particularly as they apply to purines, pyrimidines, and important coenzymes: pyridoxal, NADH, thiamine, flavines. Model enzyme studies. Lectures only.

#### CHEMISTRY C326

##### Natural Products (2 credits)

Prerequisite: CHEM C222, or equivalent, Structure determination, synthesis, and stereochemistry of various natural products. Examples from terpenes, carotenoids, steroids, alkaloids, and antibiotics. Lectures only.

#### CHEMISTRY C328

##### Organic Chemistry of Polymers (2 credits)

Prerequisite: CHEM C222 or equivalent and C232. Methods and mechanisms of

polymer synthesis. Condensation polymerization, addition polymerization, ring opening reactions. Vinyl and diene polymers. Polyesters, polyamides, etc. Lectures only.

#### CHEMISTRY C329

Organic Reactions Laboratory (2 credits)

Prerequisite: CHEM C322 or C323, previously or concurrently; CHEM C331, and C332 or C333 previously or concurrently. Experiments with reactions of synthetic and mechanistic importance. Reactions involving reactive intermediates. Kinetic and thermodynamic control. Rearrangements, Laboratory only.

#### CHEMISTRY C331

Chemical Kinetics (2 credits)

Prerequisite: CHEM C232. Topics in chemical reaction kinetics, including: mechanisms of elementary reactions; theories of chemical reaction rates; free radical reactions; factors influencing rates of reactions in solution; acid-base catalysis; catalysis by enzymes; the Michaelis-Menten mechanisms; inhibition in enzyme-catalyzed reactions. Lectures only.



### CHEMISTRY C332

Intermediate Thermodynamics (2 credits)

Prerequisite: CHEM C232. Comparison of closed and open systems. Partial molal quantities. Chemical potential. Real gases. Fugacity. Equilibrium constant. Free energy function. Ideal solutions. Real solutions. Duhem-Margules equation. Lectures only.

### CHEMISTRY C333

Intermediate Physical Chemistry for Biochemists (2 credits)

Prerequisite: CHEM C232. Activities and standard states for non-electrolytes. Activities and activity coefficients for electrolytes. Electrical and magnetic properties of molecules. Basic electrostatic ideas. Dielectric behaviour. Circular dichroism. Optical rotatory dispersion. Fluorescence. Phosphorescence. Lectures only.

### CHEMISTRY C335

Physical Chemistry of Polymers (2 credits)

Prerequisite: CHEM C222 and C232. Physical properties of polymers; polymer solution theory; molecular weight distributions and fractionation; molecular



weight determinations by colligative properties, light scattering and ultra-centrifuge techniques; kinetics of condensation and addition polymerizations; copolymerization. Lectures only.

NOTE: Students who have received credit for CHEM C435 may not take this course for credit.

#### CHEMISTRY C338

Physical Chemistry Laboratory I (2 credits)

Prerequisite: CHEM C232. Experiments in physical chemistry to illustrate some of the concepts studied previously, and to acquire basic dexterity in the physical chemistry laboratory. Laboratory only.

#### CHEMISTRY C339

Physical Chemistry Laboratory II  
(2 credits)

Prerequisite: CHEM C232. Further experiments in physical chemistry. The student will be expected to investigate more complex systems and to write meaningful laboratory reports. Laboratory only.

### CHEMISTRY C342

Chemistry of the Transition Elements  
(2 credits)

Prerequisite: CHEM C241 and C242, CHEM C211. Coordination chemistry; structure, theory of bonding, reactivity of transition metal complexes of various coordination numbers. Descriptive chemistry of transition metals of various oxidation states. Organometallic chemistry. Inorganic chemistry in biological systems. Lectures only.

### CHEMISTRY C348

Inorganic Chemistry Laboratory (1 credit)

Prerequisite: CHEM C342, previously or concurrently. Synthesis of coordination, and organometallic compounds requiring various techniques. Determination of various properties of the compounds prepared at the laboratory bench. Laboratory only.

### CHEMISTRY C372

Introductory Biochemistry I (3 credits)

Prerequisite: CHEM C222 and for Biochemistry students, CHEM C232, Thermodynamics and the role of ATP; structure and function of proteins and nucleic acids

including protein structure, enzymology, replication of DNA, transcription and translation of DNA. Lectures and laboratory.

NOTE: Students who have received credit for CHEM C371 may not take this course for credit.

### CHEMISTRY C373

Introductory Biochemistry II (3 credits)

Prerequisite: CHEM C372. Intermediary metabolism, including biosynthesis and degradation of carbohydrates, lipids and amino acids; bioenergetics and photosynthesis. Lectures and laboratory.

NOTE: Students who have received credit for CHEM C371 may not take this course for credit.

### CHEMISTRY C380

General Industrial Chemistry (2 credits)

Prerequisite: Second-year chemistry students, or permission of the Department. Broad outline of major factors to be considered by the chemical industry when contemplating manufacture of a new product or product group, with special emphasis on market determination, customs, tariffs, use of Statistics Canada data,



existing or potential competition, inherent advantages or disadvantages. Relative importance of labour versus capital; plant location; transportation considerations; by-product disposition; hazard and pollution considerations; government-regulated products; government incentives. Marketing channels; export considerations; foreign tariffs, and non-tariff barriers. Lectures only.

#### CHEMISTRY C390

Introductory Instrumentation (2 credits)

Prerequisite: CHEM C211, or two 6-credit Biology courses with laboratory; CHEM C399 concurrently. Introduction to measurement principles. Instrument design and basic techniques; analysis of basic modules in pH meters, potentiometric titrators, polarographs, gas chromatographs, photometers, and spectrophotometers, to emphasize facility in the use of similar instruments for measurement of specific systems. Lectures only.

#### CHEMISTRY C391

Chemical Spectroscopy I (3 credits)

Prerequisite: CHEM C222 and C232.  
General theories of spectroscopy.



Infrared, ultraviolet, proton magnetic resonance spectroscopies and mass spectrometry will be applied to the elucidation of the structure of organic molecules. Rates and activation energies by pmr. Lectures, problem periods and laboratory.

#### CHEMISTRY C399

Introductory Instrumentation Laboratory  
(1 credit)

Prerequisite: CHEM C211 or two full laboratory courses in Biology; CHEM C390 concurrently. Basic RLC circuits, filters, semi-conductors, transistors, transistor amplifiers, difference amplifiers, operational amplifiers. Introduction to mechanical, optical and electrical transducers and recorders; signal-to-noise optimization, digital electronics, logic circuits, and automation. Laboratory only.

#### CHEMISTRY C419

Research Project and Thesis in Analytical Chemistry (6 credits)

Prerequisite: The student must be enrolled in the Specialization in Analytical Chemistry Programme. The student will work on a research project involving a theoretical and/or practical

aspect of analytical chemistry, and will write a thesis on the results. The research project will be scrutinized by a committee of members of the Department. Experimental work and theory.

#### CHEMISTRY C421

Physical Organic Chemistry (3 credits)

Prerequisite: CHEM C322. Theory and use of sigmatropic, pericyclic, and electrocyclic reactions. Woodward-Hoffman rules, Moebius-Huckel approach. Application to thermal and photochemical reactions. Introduction to organic photochemistry. Lectures only.

#### CHEMISTRY C422

Organic Synthesis (4 credits)

Prerequisite: CHEM C322. Consideration of synthetic strategy and synthesis design. Modern synthetic methods and reagents. Exemplified by syntheses of terpenes, alkaloids, pheromones, and novel structures. Lectures and laboratory.

#### CHEMISTRY C423

Selected Topics in Organic Chemistry  
(3 credits)

Prerequisite: CHEM C321 and C322.

In-depth study of a topic of current interest. Topics may be from the areas of Heterocyclic Chemistry, Organic Photochemistry, Advanced Organic Synthesis, Theoretical Organic Chemistry, Physical Organic Chemistry, Organic Spectroscopy. Lectures only.

#### CHEMISTRY C424

Selected Topics in Organic Chemistry  
(3 credits)

Prerequisite: Permission of the Department. A student who has received credit for CHEM C423 may register for CHEM C424, provided the subject matter is different. Lectures only.

#### CHEMISTRY C431

Statistical Thermodynamics (3 credits)

Prerequisite: CHEM C331; C332 or C333. Elements of probability theory, microcanonical, canonical, and grand canonical ensembles; Boltzmann distribution; quantum mechanical treatment of an ideal gas; Fermi-Dirac and Bose-Einstein statistics; Einstein and Debye models of a monatomic crystal; conformation of polymer chains. Lectures only.



#### CHEMISTRY C432

Selected Topics in Physical Chemistry  
(3 credits)

Prerequisite: CHEM C331, C332 or C333.  
Subject matter will differ from year to year to take advantage of the special interest of the instructor concerned. The course will provide opportunities to senior students for discussion and advanced study in physical chemistry. Lectures only.

#### CHEMISTRY C433

Advanced Quantum Chemistry (3 credits)

Prerequisite: CHEM C233; C332 or C333.  
This course deals with the theories of valence for both organic and inorganic materials. Topics covered include symmetry, construction and use of character tables, valence bond theory, molecular orbital theory, crystal field theory, ligand field theory. Lectures only.

#### CHEMISTRY C434

Advanced Physical Chemistry for Biochemists  
(3 credits)

Prerequisite: CHEM C333. Thermodynamics applied to biological systems. Surface tension. Capillarity. Surface thermodynamics. Surface films. Adsorption.



Electrocapillarity. Electrokinetic effects. Transport properties. Light scattering, Zimm plot. Lectures only.

#### CHEMISTRY C437

Selected Topics in Physical Chemistry  
(3 credits)

Prerequisite: Permission of the Department. A student who has received credit for CHEM C432 may register for CHEM C437, provided the subject matter is different. Lectures only.

#### CHEMISTRY C439

Advanced Physical Chemistry Laboratory  
(3 credits)

Prerequisite: CHEM C331; C332 or C333; C339. Advanced experimentation in chemical kinetics and thermodynamics, with complete laboratory reports. Lectures and laboratory.

#### CHEMISTRY C441

Selected Topics in Inorganic Chemistry  
(3 credits)

Prerequisite: CHEM C342. Selected topics in the field of Inorganic Chemistry chosen from current interest in this field. Particular topics may include: Organo-

metallic Chemistry, Kinetics and Mechanisms of Inorganic Reactions, Electronic Spectroscopy of Transition Metal Complexes, Inorganic Photochemistry, Introduction to X-ray Crystallography, and other current topics from the literature. Lectures only.

#### CHEMISTRY C442

Physical Methods in Inorganic Chemistry  
(3 credits)

Prerequisite: CHEM C241 and C242; CHEM C211; CHEM C391, previously or concurrently. Introduction to symmetry and the character tables. Diffraction methods, X-ray, ESCA, UV-Visible, ORD and CD, EPR, Moessbauer, NQR, NMR, IR and Raman. Lectures only.

#### CHEMISTRY C443

Selected Topics in Inorganic Chemistry  
(3 credits)

Prerequisite: Permission of the Department. A student who has received credit for CHEM C441 may register for CHEM C443, provided the subject matter is different. Lectures only.

#### CHEMISTRY C449

Laboratory in Synthesis and Techniques in Inorganic Chemistry (1 credit)

Prerequisite: CHEM C442, previously or concurrently. Some of the techniques discussed in CHEM C442 will be employed in the laboratory to characterize and determine properties of compounds synthesized at the laboratory bench. Laboratory only.

#### CHEMISTRY C450

Research Project and Thesis (6 credits)

Prerequisite: Permission of the Department. The student will work on a research project under the direction of a staff member, and will write a thesis on the results.

NOTE: Students planning to take this course must consult with the Chemistry Department as early as possible the year before the final year.

#### CHEMISTRY C470

Proteins and Lipids-Structure-Function Relationships (3 credits)

Prerequisite: CHEM C372, C373. Protein conformation in relation to muscle contraction and relaxation, including ATP-myosin, actin-myosin and troponin-



Ca interactions. Structure-function analysis of immunoglobulins and antigens: amino-acid sequence, three-dimensional structure, antibody diversity, immunity, hypersensitivity, auto-immunity and graft versus host response. Biochemical and physical properties of lipids in relation to functions of biological membranes. Lectures only.

#### CHEMISTRY C471

Enzyme Kinetics and Mechanism (3 credits)

Prerequisite: CHEM C372, C373 and C331. Steady-state kinetics, including the use of initial velocity studies and product inhibition to establish a kinetic mechanism; non-steady-state kinetics, isotope effects, energy of activation, etc; detailed mechanisms of selected enzymes. Lectures only.

#### CHEMISTRY C472

Selected Topics in Biochemistry (3 credits)

Prerequisite: Permission of the Department. Selected topics in the field of Biochemistry chosen according to the interests of the instructor. Lectures only.



### CHEMISTRY C473

#### Medicinal Chemistry I (3 credits)

Prerequisite: CHEM C372 and C373.

Physicochemical principles of drug action. Influence of solubility, surface phenomena, stereochemistry and electronic properties on drug action. Nonspecific drugs, anaesthetic, membrane-active disinfectants and antibiotics. Quantitative structure-activity relationships. Receptor theory and models, methods of receptor characterization. Lectures only.

### CHEMISTRY C474

#### Medicinal Chemistry II (3 credits)

Prerequisite: CHEM C473. Drugs acting on endogenous messengers and their targets: Cholinergic, adrenergic, dopaminergic and serotonergic neuronal systems. Histamine, amino acid neurotransmitters. Steroid and peptide hormones, prostaglandins. Enzymes as drug receptors. Drug design. Lectures only.

### CHEMISTRY C475

#### Pharmacology I (3 credits)

Prerequisite: CHEM C372 and C373, BIOL C333. Pharmacokinetics, drug metabolism and interaction. Toxicology, carcino-

genetics, and teratogenicity. Drug development and testing. Lectures only.

#### CHEMISTRY C476

Pharmacology II (3 credits)

Prerequisite: CHEM C475. Autonomic nervous system pharmacology. Functions of central nervous system, depressants, stimulants. Narcotic analgesics, addition. Cardiovascular, renal, and endocrine pharmacology. Lectures only.

#### CHEMISTRY C477

Selected Topics in Biochemistry (3 credits)

Prerequisite: Permission of the Department. A student who has received credit for CHEM C472 may register for CHEM C477, provided the subject matter is different. Lectures only.

#### CHEMISTRY C479

Advanced Biochemistry Laboratory (3 credits)

Prerequisite: Any two of CHEM C470, C471, C472; previously or concurrently. This course deals with the theory and practice of modern biochemical laboratory techniques. Laboratory only.

#### CHEMISTRY C490

Advanced Instrumentation (3 credits)

Prerequisite: CHEM C390 and C399;  
CHEM C499 concurrently. Instrumental amplifiers, transducers, and measurement errors. Analog, time, and digital data domains. Optimization of electronic measurements, frequency response, sampling parameters, signal-to-noise enhancement and budget error analysis. Micro-processors for control, data acquisition, and interface to computers. Lectures only.

#### CHEMISTRY C492

Chemical Spectroscopy II (4 credits)

Prerequisite: CHEM C321, C311 and C316 or C391. Theory and application of EPR Spectroscopy, rotational spectroscopy, rotation-vibrational spectroscopy, Raman spectroscopy. Lectures and laboratory.

#### CHEMISTRY C499

Advanced Instrumentation Laboratory  
(1 credit)

Prerequisite: CHEM C390 and C399;  
CHEM C490 concurrently. Selected experiments to demonstrate the topics discussed in CHEM C490. Laboratory only.